Chapter 4
ANALYSIS

ANALYTICAL TOOLS

Computer models were used extensively to assist in development of this plan. The models represent the performance of a real system through a series of equations which describe the physical processes that occur in that system; they represent a simplified version of the real world that may be used to predict the behavior of the modeled system under various conditions. Models were used to simulate the potential impact of 1990 estimated water demands and projected water demands on the environment and ground water sources in the UEC Planning Area, during a 1-in-10 year drought condition and average rainfall conditions. Information from local comprehensive plans, utilities, University of Florida Institute of Food and Agricultural Sciences (IFAS), and the District's permitting data base was used to support this analysis. Where specific information was not available, conservative professional judgement was used.

Analytical tools used in this analysis included surface water budgets, numerical ground water models, and vulnerability mapping. Surface water budgets were used to approximate surface water availability in each of the major surface water basins in order to quantify the demands that could not be satisfied by surface water. The ground water models were used to identify potential impacts of water use on the environment and ground water resources. Vulnerability mapping was used to identify areas where there is the potential for future saltwater intrusion in the SAS. A process diagram of the analytical tools used in the UEC Water Supply Plan is located in Figure 5.

Surface Water Budgets

Surface water budgets were used to assess surface water availability for water supply in each of the major surface water basins in the UEC region (C-23, C-24, C-25, North Fork St. Lucie River, Tidal St. Lucie), except the C-44 Basin. The surface water budgets indicate whether there is a surplus or deficit (a deficit of surface water would indicate there is insufficient surface water to meet demands) of surface water in each of the major canal basins for the rainfall event chosen. For a given surface water basin, the budget considers the inflows and outflows that affect surface water storage. If inflows exceed outflows, then surface water is sufficient to meet the surface water demand. If outflows exceed inflows, then there is not sufficient surface water to meet

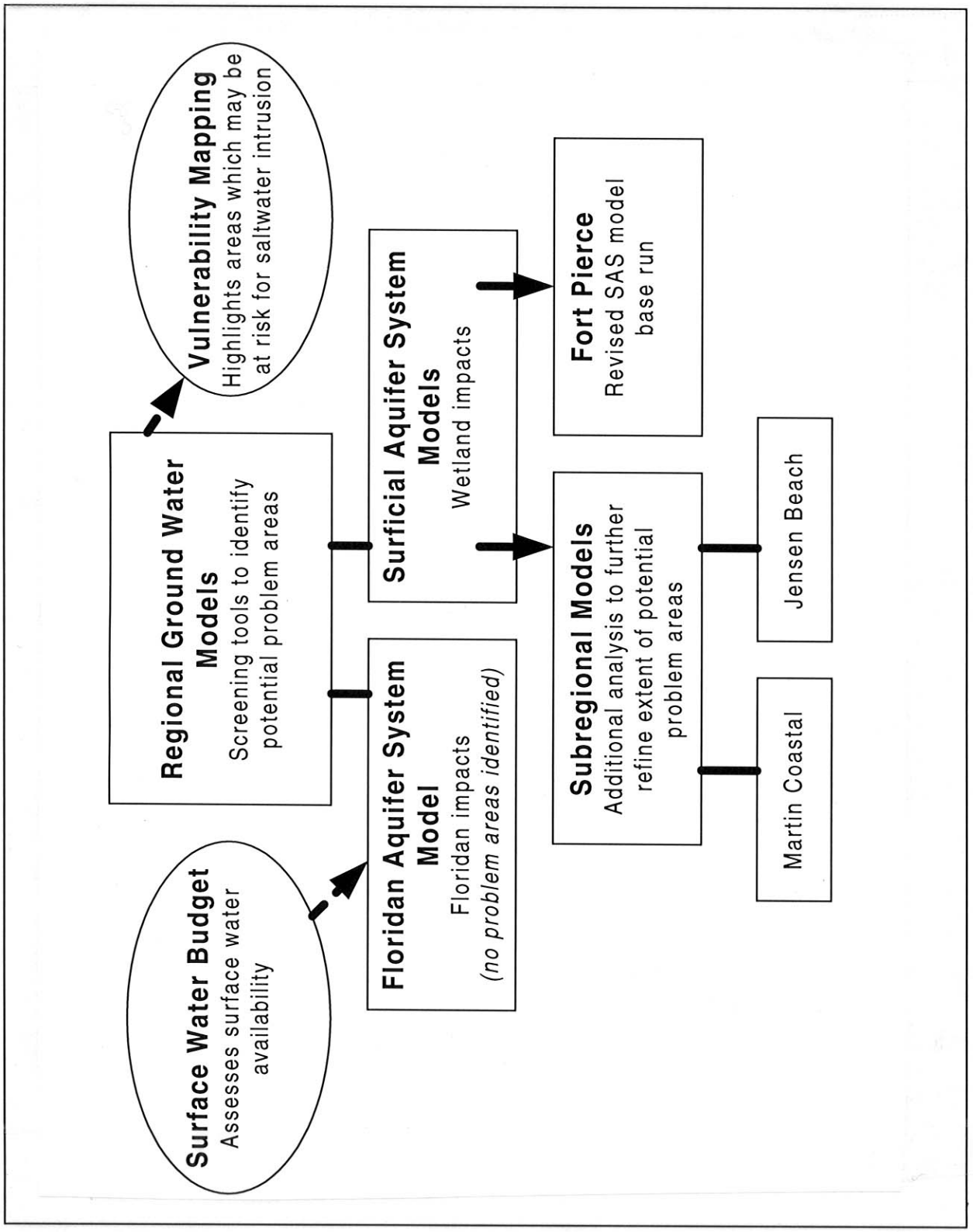

Figure 5. UEC Water Supply Plan Process Diagram and Analytical Tools.

the surface water demand. Unmet surface water needs were distributed to available ground water sources, primarily the Floridan aquifer.

The surface water budgets did not include minimum flows to the St. Lucie Estuary and Indian River Lagoon in that minimum flows have not been determined for these estuarine systems and the tools are not available to analyze the surface water implications. A discussion of minimum flows and levels is provided in Chapter 5. In addition, there are numerous combinations of potential solutions to meet the minimum flow, which are being evaluated in the Indian River Lagoon Restoration Feasibility Study. The results of these efforts will be incorporated into the five-year update of this Plan.

Ground Water Models

Ground water models used in the development of the UEC Water Supply Plan included regional and subregional models. Regional ground water models were used as screening tools to identify areas where water use, based on historical water sources and existing and proposed withdrawal facilities, is potentially impacting the environment or aquifer, during a 1-in-10 year drought condition. In locations where there were concentrated areas of potential impacts, more detailed analyses were conducted.

Based on the regional modeling results, three surficial aquifer system (SAS) areas in the UEC Planning Area were identified for additional analysis: (1) the Jensen Beach Area; (2) the Martin Coastal Area; and (3) the Fort Pierce Area. For the Jensen Beach and Martin Coastal areas, finer resolution subregional "zoom" ground water models were used to conduct the additional analysis. The Fort Pierce Area was examined in more detail using the regional SAS model with refined inputs. Figure 6 indicates the areas encompassed by the regional ground water models and the areas that required additional analysis.

Both the regional and subregional ground water models use the United States Geological Survey (USGS) modular three-dimensional finite difference ground water flow model, commonly known as MODFLOW. The area encompassed by the model is divided into cells by a model grid (defined by a system of rows and columns). The ground water models generate two principal types of output, computed head (water levels) which result from the conditions simulated, and water budgets for each active cell. The water budget shows the inflows and outflows for each of the cells. More detailed information on these models is available in the UEC Water Supply Plan Support Document.

In addition to the identified peer-review of the regional ground water models and Jensen Beach subregional ground water model during their development, the Martin Coastal model and the post-calibration modeling activities for all the ground water models were peer-reviewed for their reasonableness and appropriateness. The reviewers concluded the Martin Coastal model was acceptable, the post-calibration modeling activities were reasonable, and that the overall ground water modeling effort was appropriate for development of this water supply plan.

Regional Ground Water Models

Three regional ground water models were used to simulate the potential impacts of water use in the UEC region: (1) the Martin County Surficial Aquifer System Model; (2) the St. Lucie County Surficial Aquifer System Model; and, (3) the Floridan Aquifer System Model which encompasses the entire UEC Planning Area. The Surficial Aquifer System models are comprised of cells that are 2,000 feet by 2,000 feet, while the Floridan Aquifer System model is comprised of cells that are one mile by one mile.

These regional models were developed by District staff and documented in peer-reviewed technical publications prior to their use in the UEC Water Supply Plan effort. The regional models were updated to reflect 1990 and future water use demands.

Subregional Ground Water Models

Aside from the regional models, two finer resolution subregional SAS models were used for the Jensen Beach Area and Martin Coastal Area to determine if the potential impacts were an artifact of the scale of the regional models or water use. The ability of the ground water models to reflect the actual ground location of a withdrawal is a function of the cell size or scale used in the model. All withdrawals (wells) that fall within the boundaries of a cell are viewed as coming from the center of that cell, regardless of their specific location. Because of this, as cell sizes are decreased, withdrawals are placed closer to their actual position. The same holds true for the position of wetlands. Consequently, by using the finer scale models, the models more closely represent actual conditions.

The Jensen Beach Area subregional SAS model (Jensen Beach model) was an existing model developed by District staff and documented in a peer-reviewed technical publication that was updated for this planning effort. The Jensen Beach model encompasses the Jensen Beach peninsula in Martin County and is comprised of cells that are 240 by 240 feet. Approximately 69 Jensen Beach model cells fit into one regional model cell.

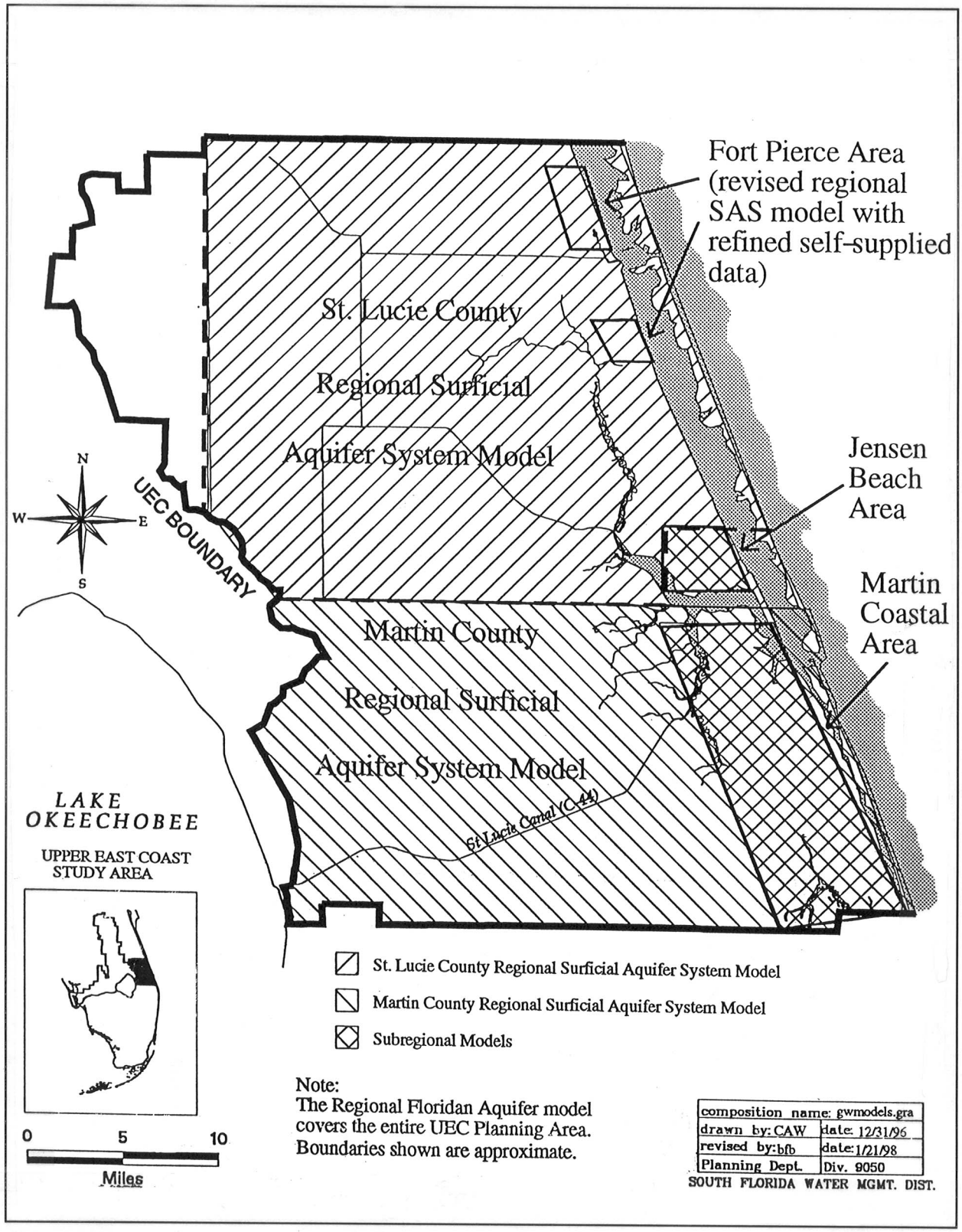

Figure 6. Regional Ground Water Modeling and Subregional Areas.

The Martin Coastal Area subregional SAS model (Martin Coastal model) was developed during the planning process and encompasses the area from the St. Lucie River south to the Loxahatchee River and from the Atlantic Ocean west to the turnpike and is comprised of cells that are 500 by 500 feet. Approximately 16 Martin Coastal model cells fit into one regional model cell. This model is further described in Appendix J.

Vulnerability Mapping

Vulnerability mapping is a technique used to identify potential problem areas, especially in water resource investigations, by weighting key factors that can cause the problem. It was used in the UEC Water Supply Plan to evaluate the potential for saltwater intrusion. The factors used in this evaluation were: water levels, proximity to saltwater, and historic changes in chloride concentrations. Several of these factors were outputs from the regional SAS models. Vulnerability mapping for this application highlights areas that have the highest potential for saltwater intrusion relative to the rest of the region. It does not determine areas that have or will have saltwater intrusion.

The inland movement of saltwater is a major resource concern in the coastal areas of the UEC Planning Area and can significantly affect water availability in areas adjacent to saline water bodies. When water is withdrawn from the surficial aquifer at a rate which exceeds its recharge capacity, the amount of freshwater head available to impede the migration of saltwater is reduced, and saltwater intrusion becomes likely. Saltwater intrusion has been identified in Hobe Sound, resulting in several wells being taken out of service.

Historically, the District's consumptive use permitting (CUP) program has required water users to maintain a minimum of one foot of freshwater head between their wellfields and saline water as a guideline for the prevention of saltwater intrusion. This guideline, in combination with a saltwater intrusion monitoring program, has been largely successful in preventing saltwater intrusion in the Upper East Coast Planning Area. Much of this effort has been carried out on a permit-by-permit basis. The approach taken in the water supply plan is intended to provide a comprehensive view of the potential for saltwater intrusion within the region. By identifying those areas most vulnerable to saltwater intrusion, the plan provides users and regulators the foundation from which to take a strong proactive approach to the management of saltwater intrusion.

RESOURCE PROTECTION CRITERIA

In order to assess the potential impacts (harm) of cumulative water use on the environment and ground water resources using the ground water modeling tools, the potential impacts must be defined in terms of water levels and duration and frequency of drawdowns. These water levels are referred to as resource protection criteria. The resource protection criteria are guidelines to identify

areas where there is potential for cumulative water use withdrawals to cause harm to wetlands and ground water resources. Areas where simulations show the resource protection criteria are exceeded during the selected level of certainty are areas where the water resource may not be sufficient to support the projected demand under the constraints.

Resource protection criteria in this plan are designed to prevent harm to the resources up to a 1-in-10 drought event. These criteria are not intended to be a minimum flow and level. For drought conditions greater than a 1-in-10 event, it may be necessary to decrease water withdrawals to avoid causing significant harm to the resource. Water shortage triggers, or water levels at which phased restrictions will be declared under the District's water shortage program, can be used to curtail withdrawals by water use types to avoid water levels declining to and below a level where significant harm to the resource could potentially occur.

There were two resource protection criteria used in this plan: the wetland resource protection criterion and the Floridan aquifer protection criterion. The advisory committee endorsed the use of these criteria. The resource protection criteria define the severity, duration, and frequency of declines in ground water levels as the result of water use withdrawals. Drawdowns in the vicinity of ground water contamination sites were not evaluated in this plan.

The related strategies section contained in Chapter 5 discussed incorporation of the criteria into the consumptive use permitting process.

Wetland Protection Criterion

The wetland protection criterion is defined as follows: *Ground water level drawdowns induced by cumulative pumping withdrawals in areas that are classified as a wetland should not exceed 1 foot at the edge of the wetland for more than 1 month during a 12-month drought condition that occurs as frequently as once every 10 years.* For planning purposes, this criterion was applied to surficial aquifer drawdowns in areas that have been classified as a wetland according to the National Wetlands Inventory.

Section 3.3, Environmental Impacts, of the District's Basis of Review for Water Use Permit Applications (BOR-1997) requires that withdrawals of water must not cause adverse impacts to environmental features sensitive to magnitude, seasonal timing and duration of inundation. Maintaining appropriate wetland hydrology (water levels and hydroperiod) is scientifically accepted as the single most critical factor in maintaining a viable wetland ecosystem (Duever, 1988; Mitch and Gossecink, 1986; Erwin, 1991). Water use induced drawdowns under wetlands potentially affect water levels, hydroperiod and the areal extent of the wetland. A guideline of no greater than one foot of drawdown at the edge of a wetland after 90 days of no recharge and maximum day withdrawals is used currently for consumptive use permitting (CUP) purposes to indicate no adverse impacts. Wetlands for CUP purposes are delineated using the statewide methodology as described in Chapter 62-340, F.A.C.

The wetland protection criteria used in this plan is intended to be consistent with the guidelines currently used in the CUP program. Modeling studies conducted in conjunction with the District's Lower West Coast Water Supply Plan suggested that the withdrawals associated with different use types might have different drawdown impacts at wetlands. It was concluded that for public water supplies, the 90-day no recharge guideline currently used was equivalent to five months of maximum day pumpage in models with 1-in-10 year drought conditions and recharge. This was also confirmed for the UEC Water Supply Plan and was included in the analysis.

The District began a research project in 1995 to support development of wetland drawdown criteria. This project involves long-term monitoring of wellfields and wetland systems including some systems (southwest corner of Savannas State Reserve in vicinity of Martin County North's wellfield, Jonathan Dickinson State Park) in the UEC Planning Area. The wetland protection criterion regarding the relationship between water use drawdowns and impacts to specific wetland types will be reviewed in the future as this field data becomes available. Additional information on this study is provided in the UEC Water Supply Plan Support Document.

Floridan Aquifer Protection Criterion

The Floridan aquifer protection criterion is defined as follows: *Ground water level drawdowns induced by water use withdrawals should not cause water levels in the Floridan aquifer to fall below land surface any time during a 12-month drought condition that occurs as frequently as once every 10 years.*

This protection criterion is established to protect the quality and sustainability of the upper portion of the Floridan aquifer (Upper Floridan aquifer), generally 800 feet below land surface in the UEC Planning Area, and to avoid impacts to existing users. The Upper Floridan aquifer is an artesian aquifer. The water quality in formations below the Upper Floridan aquifer is of lower quality (salinity is higher). If the water level in the Upper Floridan aquifer is allowed to decline below acceptable levels, the upconing of this underlying lower quality water could occur at an unacceptable rate, causing water quality degradation in the Upper Floridan aquifer. This could eventually lower the water quality in the Upper Floridan to a level unsuitable for current users.

The District's CUP program currently prohibits pumps on all flowing Floridan wells in the UEC region because of the concern of the potential for upconing of higher salinity water; and to avoid impacts to existing legal users. Impacts include the potential decline in water quality and a loss in head or water levels reducing the water available for use. Presently, there is insufficient data to conclusively define the relationship between water use, water levels and water quality. Also, the naturally occurring flow of the Floridan aquifer has been sufficient to meet the needs of the region's users. As a result, water levels in the Floridan cannot decline below land surface. Therefore, the Floridan aquifer protection criterion used in this plan is equivalent to the intent of the existing CUP program. Users located outside, but in the vicinity, of the planning area were incorporated into the analysis to evaluate their potential impacts on the UEC region.

This criterion relates to the use of the Floridan aquifer as a water source, but does not address the use of the Floridan aquifer for aquifer storage and recovery (ASR) purposes. Pumps on ASR wells is discussed in Chapter 5.

ANALYSIS

In order to determine the potential effects of projected water demands on the environment and water resources, a series of base model runs were performed. The first set of runs represented the current demands (1990) under average and 1-in-10 year drought conditions, while the second represented future demands (for the year 2020) under identical rainfall conditions. Potential problem areas were identified by applying the resource protection criteria. Resulting ground water levels were compared to model runs without the demands to determine drawdowns resulting from water withdrawals. This difference was compared to the resource protection criteria. Areas where this difference exceeded the applicable resource protection criteria were identified as a potential problem area.

Water Supply Needs

The 1990 demand level represents the estimated urban and agricultural water demand for the use type and acreage that was permitted by the District through the end of 1990. For public water supply, actual pumpage information was used. For irrigation uses, the permitted acreage was used and the associated demand was then calculated based on the simulated rainfall event. The 2010 demand level is based on 2010 population projections from local government comprehensive plans and estimated 2010 agricultural acreage. For reasons explained in more detail in Chapter 2, these numbers are also reasonable and justified conditions for 2020.

All irrigation demands were calculated using the modified Blaney-Criddle method for each rainfall condition. A detailed discussion of this method can be found in the District's Management of Water Use Permitting Information Manual, Volume III (1994). Blaney-Criddle is currently used in estimating supplemental crop requirements in the District's consumptive use permitting program.

Public water supply and residential self-supplied demands were based on historic per capita water use and monthly distribution patterns. For the regional model runs, self-supplied demand, which is not usually incorporated in the cumulative analysis associated with consumptive use permitting, was uniformly distributed over utility service areas and planning areas. No recharge from septic tanks was incorporated into the analysis, but local public health units estimate these systems are treating up to 8 mgd in the UEC Planning Area (additional information provided in wastewater reuse section in Chapter 5). Recharge from septic tanks could potentially offset potential impacts from residential self-supplied users, since many wells coexist with septic tanks.

Level of Certainty

Two rainfall conditions were simulated to identify the difference between likely chronic problems, occurring under average rainfall conditions, versus problems expected only during droughts. A 12-month dry rainfall event that occurs, statistically, no more frequently than once every ten years was simulated for each county. This rainfall event is referred to as a 1-in-10 year drought condition or a 1-in-10 level of certainty. The advisory committee and staff concluded a 1-in-10 drought condition was a reasonable rainfall scenario for the plan to balance the needs of urban and agricultural users, and the environment while maximizing the use of resource. It also provides a uniform rainfall scenario to base demands and resource impacts on. This level of certainty was codified as a planning goal in Chapter 373, F.S. during the 1997 legislative session. The CUP program currently uses a 2-in-10 year drought condition and a 90-day no recharge resource impact guideline.

Model Simulations

"Base case" model runs were conducted using both the 1990 estimated demand level (1990 base case) and the 2020 projected demand level (future base case). The future base case assumed water use characteristics and management conditions would remain the same. It was assumed that future water users would obtain water from the same sources as existing users. It was further assumed that existing water users would utilize the same sources for both their current and future demands unless information was made available indicating a change. The existing and projected use of reclaimed water (where information was available) was incorporated into the simulations, as well as reductions in public water supply water use resulting from implementation of mandatory conservation measures.

Base case runs represent the "do nothing" approach and not necessarily the likely scenario. Public water supply demand for the projected population was taken from existing facilities and/or proposed facilities that were not necessarily intended to supply that level of demand. Also, the wetland protection criterion applied in these modeling runs was intended to replicate the effect of the 90-day no-recharge guideline currently applied in the District's CUP program, but for the 1-in-10 drought condition. In order to do this, the simulation of public water supply requires that utilities pump at their maximum daily demand for much longer periods than they would ever be likely to do. While this approach may be based on some assumptions that are unlikely to occur, it provides a means for comparison against alternative approaches.

Overview of Plan and Permitting Criteria

A comparison of the assumptions used in development of the UEC Water Supply Plan with the guidelines/criteria used in the District's consumptive use permitting program is provided in Table 6.

Table 6. Comparison of UEC Water Supply Plan and Consumptive Use Permitting Guidelines and Criteria.

	Upper East Coast Water Supply Plan	Consumptive Use Permitting Program
Rainfall Event	Statistical 1-in-10	IFAS 2-in-10
Duration	1990-2020	Varies, usually 5-10 years
Supplemental Needs	Blaney-Criddle	Blaney-Criddle
•Citrus (1985-1993)	1-in-10 annual 1-in-10 max month	14.40" annual 5.30" max month
•Citrus (1993-present)	1-in-10 annual 1-in-10 max month	2-in-10 annual Full ET max month
•Other crops and landscaping	1-in-10 annual 1-in-10 max month	2-in-10 annual 2-in-10 max month
Cumulative Analysis •Self-supplied	Yes Yes	Case-by-case No
RESOURCE PROTECTION • Wetlands -Wetland Delineation	 1 foot for greater than 1 month during a 1-in-10 drought event NWI	 1 foot after 90 days of no recharge and max. day withdrawals Chapter 62-340, F.A.C.
•Floridan aquifer	Land surface	Land surface
•Saltwater intrusion	Vulnerability	1 foot mound of fresh water

RESULTS OF ANALYSIS

Surface Water Budget Results

A surface water budget was prepared for each major surface water basin in the UEC Planning Area: C-23, C-24, C-25, North Fork St. Lucie River, Tidal St. Lucie, except the C-44 basin (Figure 7) Storage data in this analysis was based on canal design specifications. The surface water budgets did not include minimum flows to the SLE and IRL because they have not been determined for these estuarine systems. A discussion of minimum flows and levels is provided in Chapter 5.

The C-44 basin was omitted, because it is unique among the other basins in that it receives water from Lake Okeechobee. During periods of water shortage in the Lake, water supply allocations are determined through procedures described in the Lake Okeechobee Supply-Side Management Plan. This plan states that the amount of water that is available for use during any period is a function of the anticipated rainfall and water demands for the balance of the dry season in relation to the amount of water currently in storage. The management plan is explained in greater detail in the Support Document.

The C&SF Comprehensive Review Study (Restudy) is currently evaluating alternative operational plans for the Lake in an attempt to optimize the natural resources within the Lake, water supply for restoring the natural hydropattern of the Everglades, and flows to the estuaries without adversely

impacting flood control or urban and agricultural water supply. Since future Lake operations are uncertain while the Restudy evaluations are ongoing, the C-44 basin was omitted from the plan analysis. For this planning purpose, it was assumed that any deficit in the basin would be satisfied with water from Lake Okeechobee. The five-year update of this plan will incorporate the Restudy findings and address any C-44 basin deficits once they have been identified.

All basins had surface water deficits during a 1-in-10 year drought condition, except for the Tidal St. Lucie basin. The volume of the deficits varied significantly from month to month, with April and July being the largest. Annual surface water deficit estimates for a 1-in-10 drought condition and projected demands are shown in Table 7. Monthly information is contained in Appendix J.

Table 7. Annual Surface Water Deficit Estimates for a 1-in-10 Drought Condition.

	Surface Water Basin					
	C-23	C-24	C-25	C-44	North Fork St. Lucie River	Tidal St. Lucie
Acre-feet†	48,476	23,372	49,724	0	18, 589	0
MGD*	43.27	20.88	44.38	0	16.60	0

† Does not incorporate minimum flows to SLE and IRL

*Determined by converting acre-feet to MG and dividing by 365

Unmet surface water needs were distributed to available ground water sources, primarily the Floridan aquifer. Potential problems exist when the ground water sources cannot support the additional demands placed on them by deficits in surface water availability.

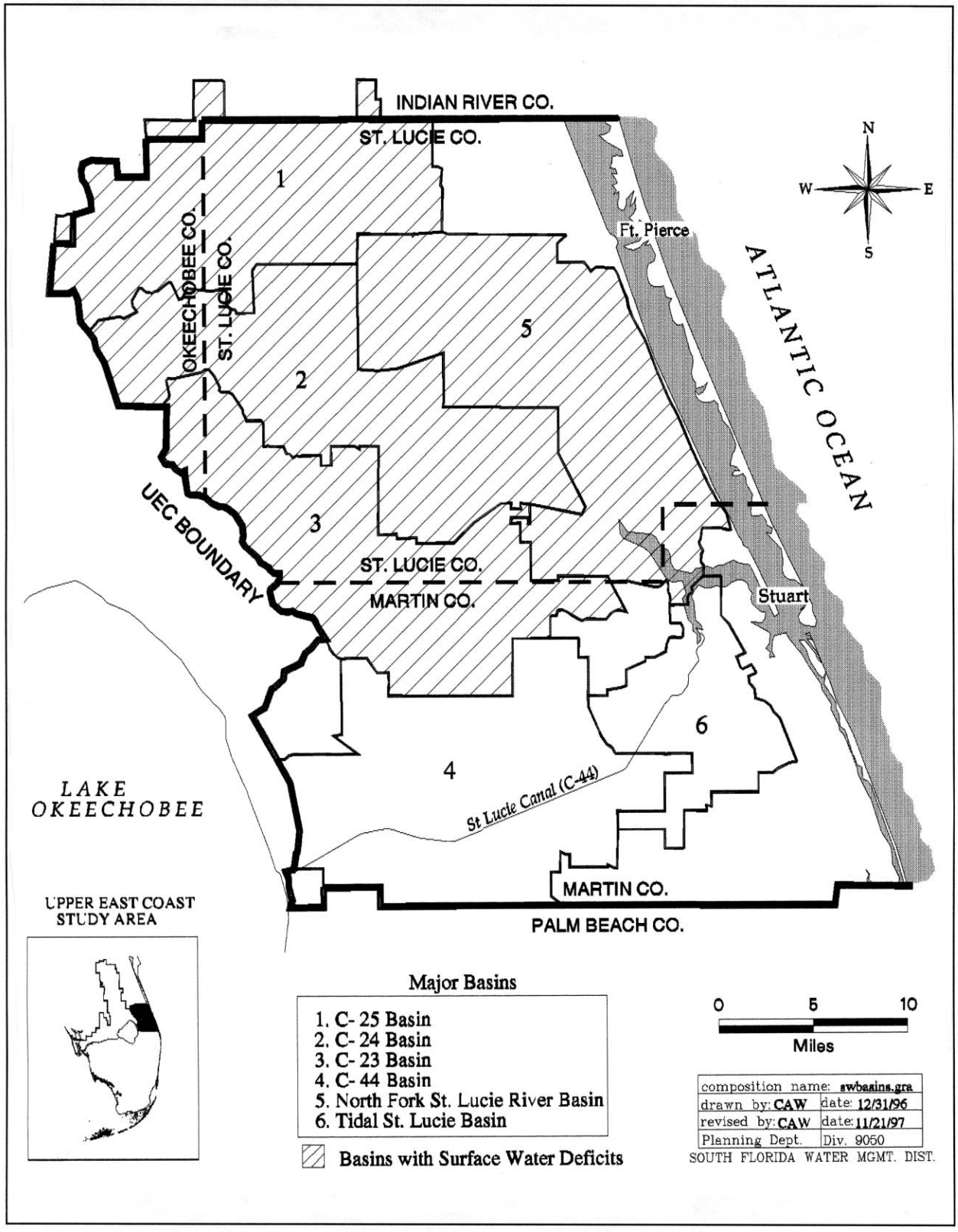

Figure 7. Major Surface Water Basins in the UEC Planning Area.

Regional Ground Water Modeling Results

Floridan Aquifer System. The regional Floridan aquifer modeling runs did not reveal any water use related exceedances of the Floridan aquifer protection criterion in 1990 or 2020. However, there are several natural exceedances along the western ridge in the UEC Planning Area (Figure 8). Natural exceedances are areas where the water level in the Floridan aquifer is naturally below land surface. These areas were determined by running the Floridan model with all demands turned off and comparing resulting water levels with land surface elevations and are located in topographic highs.

Martin and St. Lucie Counties Surficial Aquifer System. The results of the regional base case Surficial Aquifer System ground water simulations for Martin and St. Lucie counties showed where there was a potential for water use drawdowns to exceed the wetland protection criterion. In Martin County, the results indicated there was the potential for 1,084 acres of wetland protection criterion exceedances in 1990 during a 1-in-10 drought event. Moreover, almost 90 percent of these potential exceedances also occurred under average rainfall conditions. The potential for future wetland protection criterion exceedances are projected to increase to 1,682 acres under 1-in-10 year drought conditions with approximately 85 percent of these concentrated along the coast, between Stuart and Hobe Sound. The total area of wetlands incorporated in the simulation for Martin County was 67,585 acres.

In St. Lucie County, the results indicated there was the potential for 344 acres of wetland protection criterion exceedances in 1990 during a 1-in-10 drought event. Almost 72 percent of these also occurred under average rainfall conditions. The potential for future wetland protection criterion exceedances are projected to increase to 901 acres under 1-in-10 year drought conditions. The total area of wetlands incorporated in the simulation for St. Lucie County was 41,007 acres. A majority of these potential exceedances are located in the vicinity of Jensen Beach, and north and south of Fort Pierce near the coast.

Based on these results, it was decided that additional analysis was necessary in the Martin Coastal, Jensen Beach, and Fort Pierce areas to indicate whether the exceedances were the result of the model scale or water use, and to better understand the causes of the impacts. The results of the subregional analysis of these areas are discussed below.

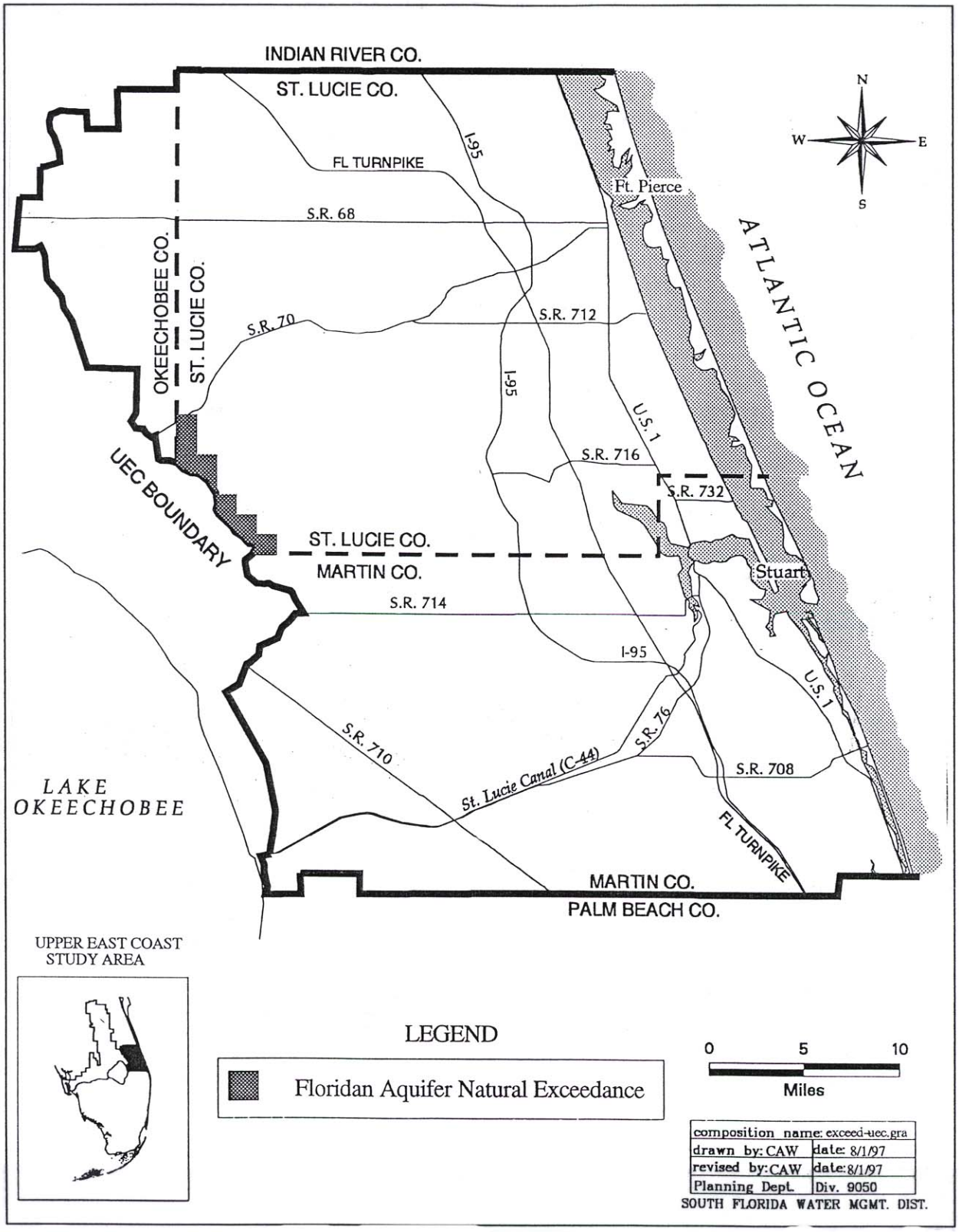

Figure 8. Floridan Aquifer Natural Exceedance Areas.

Subregional Ground Water Modeling Results

The regional SAS modeling results identified three areas where there were concentrated areas of potential wetland protection criterion exceedances: the Jensen Beach Area (subregion 1), the Martin Coastal Area (subregion 2), and the Fort Pierce Area (subregion 3). These subregional areas are identified in Figure 6.

More refined data inputs were developed for each of the three areas. Specifically, rather than distributing domestic self-supplied demand evenly over an entire planning or utility service area, more precise locations for domestic self-supplied and small water treatment "package" plant withdrawals were determined by looking at aerial photographs and meeting with utility representatives.

Subregion 1: Jensen Beach Area. The Jensen Beach model was used in this evaluation. In addition to the changes made in self-supplied distribution, information for the Martin County North water system was also updated based on a recent water use permit approved by the District in August 1996. This water use permit authorized changes to Martin County's wellfield configuration and placed specific limitations on operations of the wellfield, including maximum permitted withdrawals for each well. The net effect of these changes was lower permitted withdrawals compared to actual 1990 pumpage.

Jensen Beach Modeling Results. A base model run was conducted using 2010 projected demands and a 1-in-10 drought condition. The results of the Jensen Beach modeling indicated a significant reduction in potential wetland protection criterion exceedances from the regional model runs, especially north of Jensen Beach Boulevard. However, potential future wetland protection criterion exceedances are projected under approximately 91 acres of wetlands (out of 1,657 total acres of wetlands) during a 1-in-10 drought condition. This decrease in the potential problem areas from 1990 was primarily due to Martin County's North System reducing its dependence on the SAS with development of the Floridan aquifer.

Several sensitivity runs were done to determine the contribution of the major user groups (public water supply, domestic self-supplied, package plants) on these projected exceedances. The results indicate that pumpage from package plants had no influence on the exceedances because of their location and size of withdrawals, while domestic self-supplied demand is contributing at most two tenths of a foot drawdown in some areas. However, when domestic self-supplied drawdown is added to Martin County's North System drawdown, the number of acres of exceedances almost doubles. The results suggest that the Martin County North water system is the principal cause of the projected ground water drawdowns. They also show how minor increases in drawdowns cause significant increases in wetland protection criterion exceedances, suggesting that future expansion of withdrawals from the SAS in this area is limited.

Jensen Beach Conclusions. Based on the analysis, the following conclusions were made:

- While there are several package plants in the area, they are not contributing to the wetland protection criterion exceedances.

- Domestic self-supplied impact is minimal; however, it is contributing to a cumulative impact such that there is some benefit to reducing domestic self-supplied.
- Martin County North water system is having the greatest contribution to drawdowns in the area.
- Drawdowns under wetlands are projected to approach or exceed wetland protection criterion with or without domestic self-supplied.
- Future expansion of the SAS is limited.

Jensen Beach Water Source Options. To address the potential wetland exceedances, several options to increase water supply or reduce demand were considered. Martin County North water system has implemented many of the water supply alternatives usually considered for evaluation. These include: using the Floridan Aquifer and reverse osmosis; expanding the SAS wellfield to maximize its use; developing an interconnected water system; and, initiating a wastewater reuse program.

The UEC Water Supply Plan Advisory Committee concluded aquifer storage and recovery (ASR) was not a promising alternative for the Jensen Beach Area at this time because of the lack of a sufficient supply source. For ASR to be feasible, a supply source that has a sufficient surplus of water during a portion of the year has to be available. Such a source does not currently exist in the Jensen Beach Area.

Martin County has been working with the District since 1990 to adjust pumpages and well locations in the Jensen Beach Area to satisfy the wetland protection guidelines. Due to the extensive use of customary solutions, no additional water supply alternatives were identified during advisory committee discussions for the Martin County North water system.

The benefits of connecting residential self-supplied to the public water system were discussed. The advisory committee suggested identifying key subdivisions that could be encouraged to connect to public water supply. This could be accomplished by targeting these areas through incentive based programs (for example, cost sharing) and educational programs.

The advisory committee recognized that most of the demand in Jensen Beach is associated with residential use, both indoor and outdoor. Aside from the measures incorporated into the utility water conservation program, the advisory committee suggested an urban mobile laboratory in this area might be effective in reducing water use. The laboratory would evaluate current outdoor use practices and identify ways to use water more efficiently. It would also educate residents through homeowner meetings on how to use water more efficiently.

Jensen Beach Recommendations. The UEC Water Supply Plan Advisory Committee discussed the following options for the Jensen Beach Area:

- Martin County Utilities should continue to evaluate alternative water supply options to resolve potential wetland impacts.
- Future and expanded uses in the Jensen Beach Area should be encouraged to use an alternative water supply, where effective and economical.

- Encourage existing residential self-supplied users to convert to public water supply, where effective and economical. (A future task associated with this recommendation is to identify key subdivisions to be encouraged to pursue connection to public water supply).
- Encourage funding for Martin County Urban Mobile Laboratory in this area.
- Promote an active reuse program in the Jensen Beach Area. (Since this discussion, Martin County Utilities has implemented reuse in the Jensen Beach area for irrigation of a golf course and residential lots in a new development north of Jensen Beach Boulevard, committing 100 percent of their existing reclaimed water volume. The reuse system will be expanded as wastewater flows increase).

The committee later concluded that many of these options are too specific for a regional water supply plan, and the plan should not prescribe detailed local solutions. They concluded these are issues that need to be addressed at the local level.

Subregion 2: Martin Coastal Area. The Martin Coastal model was used in this evaluation.

Martin Coastal Modeling Results. A base model run was conducted using 2010 projected demands and a 1-in-10 drought condition. Compared to the regional model runs, the results of the Martin Coastal modeling indicated a 40 percent reduction in areas exceeding the wetland protection criterion exceedances from the regional runs. However, potential future wetland protection criterion exceedances are projected under approximately 860 acres of wetlands (out of 12,844 total acres of wetlands) during a 1-in-10 drought condition.

Several sensitivity runs were done to determine the contribution of the major user groups to these potential exceedances. Removing domestic self-supplied demand from the modeling reduced the potential exceedances by 97 acres. Removing all irrigation demand from the modeling reduced the potential exceedances by 349 acres. Eliminating public water supply demand resulted in 608 acres fewer potential exceedances. Some of the same potential exceedances disappeared with each use type, indicating some overlapping influence.

Several of these potential exceedances occur in 1990 as well asunder projected future conditions. Since 1990 model runs simulate permitted use, theoretically there should be few areas that do not meet the protection criteria in 1990. Some reasons why an exceedance may show up in this analysis but not during the permitting process are: (1) the regulatory process does not consider the impact of self-supplied demand; (2) cumulative impacts were not assessed on some of the permits; (3) there may be differences between the National Wetland Inventory and wetlands identified by District staff during the permitting process; and, (4) there are cases where a permit contains specific limitations, such as a specific wellfield operating schedule, that was not able to be simulated in the context of this regional scale modeling.

Martin Coastal Conclusions. The exceedances were broken into four areas (Figure 9) and were discussed individually by the advisory committee. These discussions were less detailed than the Jensen Beach Area discussions. Based on the analysis, the following conclusions were made:

Port Salerno Area (Area 1)

- Potential impacts result from the cumulative effect of multiple use categories.
- Future expansion of surficial aquifer use is limited.
- Self-supply's contribution alone is minimal; it only impacts already borderline areas.
- The current water supply system, without modifications, appears unable to meet future demands.
- Four of six golf courses are using reclaimed water and have minimal, if any, contribution to impacts.
- The results illustrate the delicate balance of demands on the surficial aquifer; even minor increases in drawdown can result in additional potential impacts.
- Unless alternative water supplies are utilized, future growth of public water supply is limited.

West of Hobe Sound (Area 2)

- Agriculture is the only water use in the area and uses a combination of groundwater and surface water.
- The agricultural area is already at highest efficiency (85%).
- Increased surface water availability may help the situation.
- This area appears to be a local situation and should be addressed through the permitting process rather the planning process.

Hobe Sound, north of bridge road (Area 3)

- Potential impacts result from the cumulative effect of multiple use categories.
- Future expansion of surficial aquifer use is limited.
- Self-supply's contribution alone is minimal; it only impacts already borderline areas.
- The current water supply system, without modifications, appears unable to meet future demands.
- The results illustrate the delicate balance of demands on the surficial aquifer; even minor increases in drawdown can result in additional potential impacts.
- Unless alternative water supplies are utilized, future growth of public water supply is limited.
- Agriculture's contribution, alone, is minimal but contributes to cumulative impacts.
- Most golf courses have minimal contribution to impacts due to use of reclaimed water in this area.
- There is little difference between 1990 and future projected exceedances due to minimal projected increase in PWS demands.

Hobe Sound, south of Bridge Road (Area 4)

- Potential impacts are primarily the result of public water supply withdrawals, not the cumulative effect of multiple use categories.
- Future expansion of surficial aquifer use is limited.
- Self-supply's contribution alone is minimal; it only impacts already borderline areas.
- The current water supply system, without modifications, appears unable to meet future demands.

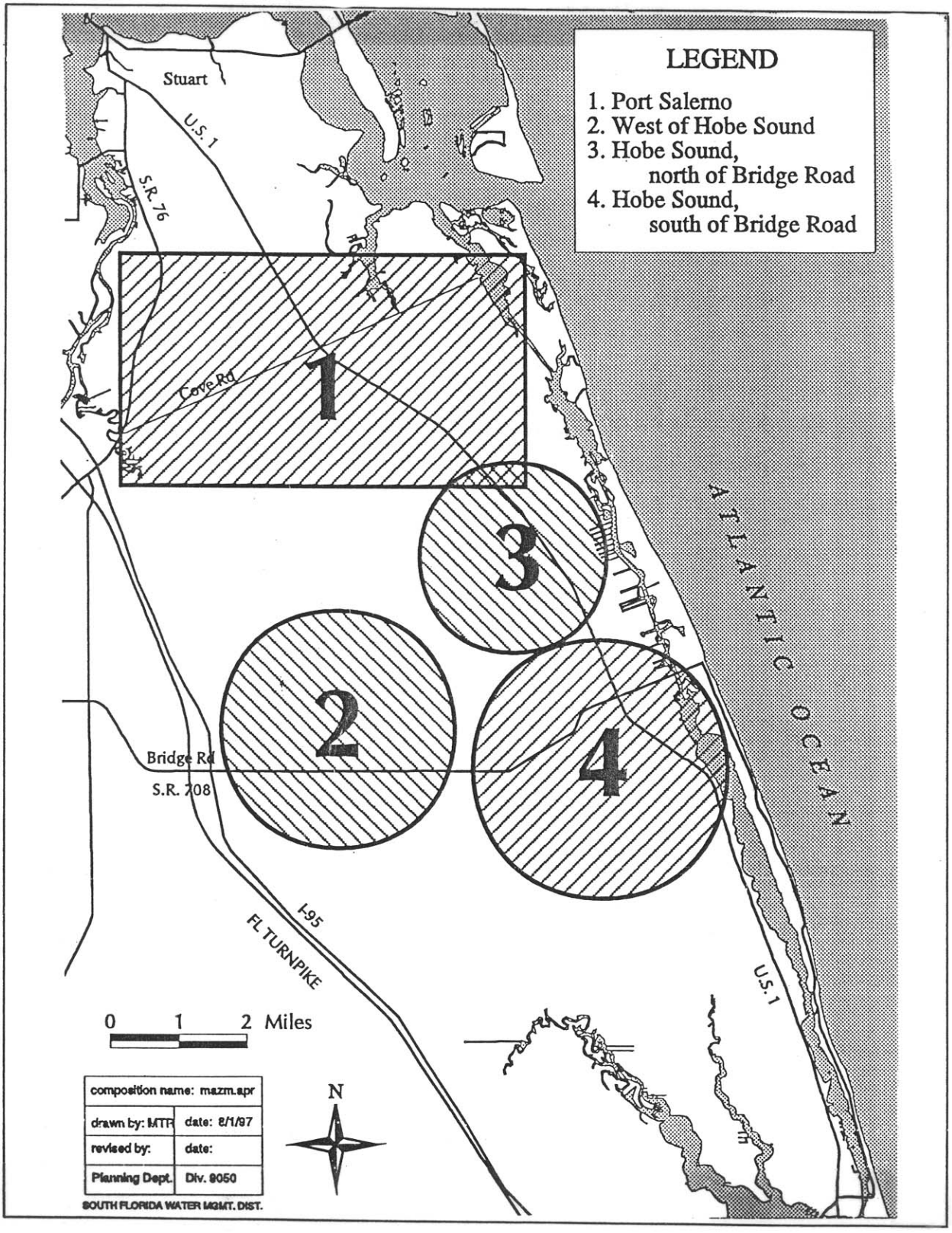

Figure 9. Martin Coastal Discussion Areas.

- The results illustrate the delicate balance of demands on the surficial aquifer; even minor increases in drawdown can result in additional potential impacts.
- Unless alternative water supplies are utilized, future growth of public water supply is limited.
- The utility is required to develop a long-term plan to meet demands and resolve saltwater intrusion and wetland issues (per consent order).
- One of two golf courses in area use reclaimed water for portion of needs, reducing their contribution to exceedances. A third used potable water for irrigation.
- Future demands may be overestimated due to the use of the current per capita rate in the projection. (Jupiter Island Golf Course using potable water for irrigation. They are in the process of constructing Floridan wells and a R.O. plant, removing this demand from potable water system).

Martin Coastal Water Source Options. Based on these conclusions, the advisory committee discussed several regional strategies to meet this future demand, including:

- Increase use of reclaimed water in area as larger wastewater stream becomes available.
- Require long-term (minimum 10 years) plans for utilities to be consistent with the regional water supply plan.
- Floridan aquifer has potential to play a key role in future water supply for area.
- Investigate how to avoid loss of water to tides and export of water outside the area.
- Employ cumulative analysis, including self-supply, during permitting analysis.

Martin Coastal Recommendations. Regarding reclaimed water, the advisory committee recommended increasing the use of reclaimed water in the area when a larger wastewater stream becomes available and develop regulatory (including wet weather disposal through FDEP and Chapter 62-610, F.A.C.) and fiscal incentives for reuse. Most importantly, the advisory committee stressed the need to prioritize areas in the District for reuse and to target incentive programs in these areas.

There was significant debate over the requirement for long-term utility plans because planning for the duration of a consumptive use permit is required through the permitting process, and additional requirements may not be necessary. The role of the Floridan aquifer and how to avoid loss of water to tide/export to other

areas were not discussed during this part of the process, but are discussed in Chapter 5.

Employing a cumulative analysis as part of the permitting analysis was discussed at the technical workshop. Participants at the workshop concluded employing a cumulative analysis as part of the permitting analysis was acceptable as long as the regulatory process has the flexibility to deal with local conditions and new technologies to accurately assess if the proposed use is permittable. Consistency with the plan recommendations will be assured through consistent assessment of demands and acceptable resource impacts as defined in this plan.

The advisory committee also suggested: (1) developing incentives for implementation of water conservation measures such as constructing onsite storage; (2) looking at reuse as an option for existing as well as future land use; (3) determining how proposed large-scale developments, such as SeaWind, are incorporated into this plan; and, (4) the plan needs to state that as significant changes in future land use occur, an evaluation of the regional water supply impacts should be done.

Subregion 3: Fort Pierce Area. To conduct this evaluation, a different approach was employed in the Fort Pierce Area than the Martin Coastal and Jensen Beach areas, where subregional models were used. In the Fort Pierce Area, most of the potential resource protection criterion exceedances were located outside of utility service area boundaries and within planning areas that are self-supplied. Therefore, the St. Lucie County regional SAS model was re-run using the refined self-supplied coverage as described earlier to determine if the exceedances were an artifact of the self-supplied methodology. A large portion of the St. Lucie County regional exceedances were located in Jensen Beach, which have been addressed by the Jensen Beach Area subregional modeling.

Fort Pierce Area Modeling Results. The revised regional modeling base run using this new self-supplied distribution resulted in a significant decrease in the number of potential resource protection criterion exceedances. About 150 acres of scattered exceedances remain for future conditions during a 1-in-10 drought event; 64 of these acres were also present in 1990. The exceedances are due in part to public water supply, self-supply and agricultural water use, with some cumulative impacts in the St. Lucie West area.

Fort Pierce Area Conclusions. It was concluded that some cumulative impacts are potentially occurring; however, most of the exceedances are the result of individual users. This is a local situation and should be addressed through the permitting process, rather than the planning process. The committee also recommended encouraging funding for a St. Lucie County Urban Mobile Irrigation Laboratory.

Saltwater Intrusion Vulnerability Mapping Results

The saltwater intrusion evaluation was accomplished through vulnerability mapping. This proactive approach provides a comprehensive view of the potential for saltwater intrusion in the region. It does not identify areas that have or will have saltwater intrusion during a 1-in-10 drought condition, but areas within the region that have the greatest potential for saltwater intrusion. This analysis did not include the barrier islands.

The analysis indicates the areas with the greatest potential for saltwater intrusion in the UEC Planning Area at future demand levels during a 1-in-10 drought condition are the coastal areas of the region (Figure 10). Several of these are adjacent to public water supply wellfields.

In these areas, existing proposed withdrawals should be carefully evaluated by the user and District during the CUP process with respect to saltwater intrusion, including the use of alternative sources of water. In addition to providing guidance for the CUP process, this information should be used as a planning tool in identifying future withdrawal locations. This is generally consistent with the existing CUP requirements, and will not result in substantive changes to the permitting program.

The USGS, in cooperation with the District, is conducting a study to delineate the location of the saltwater interface throughout the planning area. The results of this study should be available by the end of 1999.

SUMMARY OF RESULTS

Based on the results of the analysis, there are several potential water supply problems projected to occur by 2020 during a 1-in-10 drought event using current facilities and historical sources of water. Some of these potential problems were also evident in the 1990, 1-in-10 drought condition and average rainfall simulations. In addition, freshwater discharges to the St. Lucie Estuary and the Indian River Lagoon are problematic in maintaining a healthy estuarine system. The timing and volume of these discharges may have important water supply implications. A summary of the issues in the UEC Planning Area is provided in Table 8.

Resolution of these issues was the focus of the discussions of water supply options and the alternative analysis by staff and the advisory committee. In some areas, ground water contamination may be an issue, but its effect was not incorporated into this analysis.

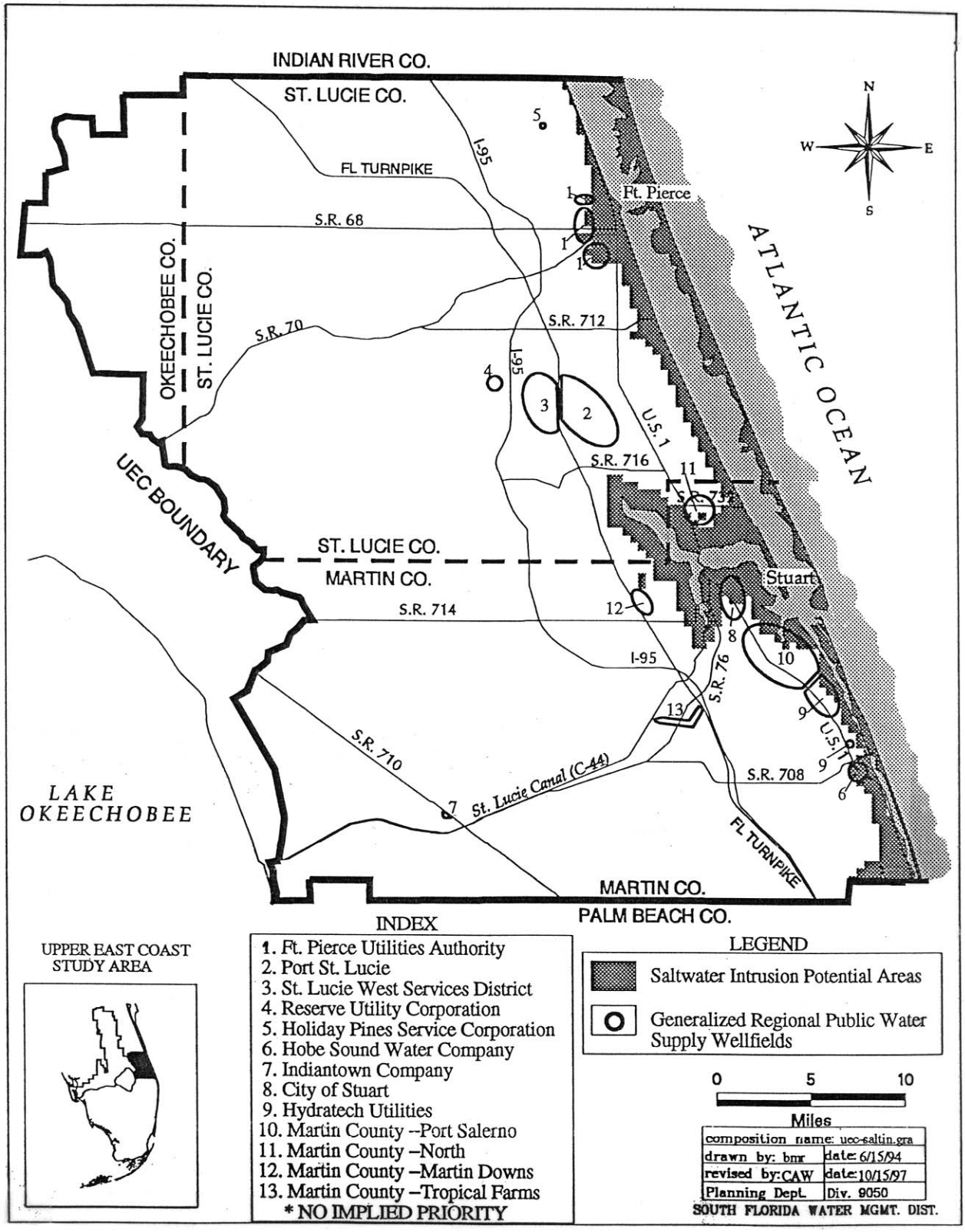

Figure 10. Areas with Greatest Potential for Saltwater Intrusion in UEC Planning Area.

Table 8. Upper East Coast Water Supply Issues Summary.

	Inland	Coastal
St. Lucie County	• Surface water availability • Floridan water quality • Watershed management options – discharges to SLE & IRL	• Cumulative impacts (wetlands) • Saltwater intrusion vulnerability • Watershed management options - discharges to SLE & IRL
Martin County	• Surface water availability in C-23 Basin • Watershed management options – discharges to SLE & IRL	• Cumulative impacts (wetlands) • Expansion of SAS limited • Saltwater intrusion vulnerability • Watershed management options - discharges to SLE & IRL